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SCIENTIFIC INVESTIGATION

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OF

DISEASE IN ANIMALS AND MAN.

BY

A FELLOW OF THE ROYAL SOCIETY AND OF THE
ROYAL COLLEGE OF PHYSICIANS.

"The old order changeth, yielding place to new,
And God fulfils himself in many ways,
Lest one good custom should corrupt the world."

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ON THE

SCIENTIFIC INVESTIGATION OF DISEASE IN ANIMALS AND MAN.

THE following remarks have been called forth by observations which have lately appeared in the public journals with reference to the scientific investigation of the cattle plague, but they apply to the method of conducting scientific inquiries generally into the exact nature of disease, a subject which seems to me to deserve greater attention than it has hitherto received from the public.

The opinion that the nature of disease should form the subject of a thorough scientific investigation seems now to be gaining ground. The little real knowledge we possess concerning the nature and properties of contagious poisons which have been so fatal in all ages, to man and to domestic animals, must have struck every intelligent person. Not only have earnest physicians felt and acknowledged their ignorance, but the difficulty of the investigation seems to be such that all their attempts to ascertain exactly how contagious diseases originate and spread have failed.

But in these days the means at our disposal for investigating such questions are far more efficient than was formerly the case, and they are becoming more and more perfect every day, while from time to time completely new methods of inquiry are discovered. The public may, therefore, feel desirous that the question should now be subjected to still more careful and minute scientific investigation. But it is doubtful if many who hold this opinion have any accurate conception

of what is involved in a thorough scientific inquiry. Not a few would consider that the only object in undertaking such an inquiry was to discover a method for preventing or curing the malady, and, without doubt, this is the great practical end, which no one more than a scientific man desires to achieve; but yet it is certain that laborious and life-long investigations are prosecuted from other motives than this; and if there were no other motives, poor indeed would be the scientific work and, it may be added, few would be the practical results. Not a few scientific researches will appear to many as if they had been undertaken with no object whatever, and even the greatest *scientific* successes have been regarded as worthless by men who consider they possess a very large share of common sense, simply because they would not be at the pains to ascertain the general bearing of the researches in question. Moreover, every disease that we are acquainted with, and especially all contagious diseases, including those of animals, have been studied over and over again by most excellent observers and thoroughly practical persons, for the definite purpose of discovering a remedy and for diminishing their ravages, and hitherto, it must be confessed, with a few remarkable exceptions, with very limited success.

It would therefore seem, that if new scientific inquiries are to be entered upon, they must be undertaken by persons actuated, if by these, at least by other motives as well, for it is certain that the prospect of discovering anything practically useful is so small in proportion to the thought and labour and money that must be expended in the investigation, that it will never be taken up—and if taken up would not be patiently prosecuted to a conclusion—by those who work solely for success, or by those who work solely for pay. Such an investigation must be conducted in a spirit of *pure inquiry*, and he who undertakes it does so with the determination to study and to work, conscious that all his study and all his work may be without practical, or, in the ordinary sense, useful results. But there are men who love study, and who love work apparently for the sake of work and study, or for the mental pleasure to be derived from work and study, and not alone

for the rewards that even the greatest success may bring. In many instances the hope that the inquiry itself, although leading to no useful results, may stimulate others to work on beyond the point arrived at, or the conviction that practical results may follow after many years, stimulates men in the prosecution of laborious research. And there can be no doubt that the man engaged in minute research is often buoyed up by hopes, vain though they often prove, that the special inquiry in which he is engaged may at length enable him to arrive at some important, highly interesting, and, perhaps, useful generalisation.

But it is scarcely worth while discussing what particular motives men have in pursuing unremunerative work. It is sufficient that the work is done, for it is well known that real advance is made by those who work for work's own sake, and not by those who are obliged to work that they may live, or by those who work that they may live easily.

Much labour and money have been spent in obtaining statistical information concerning many diseases. Careful observations of a general kind have been prosecuted, and doubtless thoroughly well prosecuted, and accurately recorded for Government, and an enormous amount of information has been published in Blue books. But why can we not have, in addition to this, the results of very minute and careful investigations by several physicists, chemists, and microscopists?

But it may truly be said that scientific men have already been called upon to undertake scientific work for several departments of Government and for Royal Commissions, but the sums awarded on few occasions for purely scientific work have been so very small, that it seems probable that those who advised the expenditure were either quite ignorant of the nature of the work to be undertaken and of the time it would occupy, or were careless whether Government and the public were informed of the advantages likely to result from the continued and thorough prosecution of such work. The public does not object to spend money in scientific experiments relating to the construction of guns and ships, and every man of common sense is convinced that it is right that

new experiments should be tried year after year. I cannot but think that if attention had been properly directed to the real importance of the scientific investigation of disease, the public would have desired that the investigation should have commenced long since, and be continuously prosecuted. Instead of the matter being openly explained, the propriety of obtaining the paid services of scientific men has been so timidly if not apologetically suggested, that it would almost seem as if those who advocated and recommended scientific work were doubtful if they were doing right, or were afraid of being laughed at.

It may be urged that the results of the scientific inquiries here advocated would be useless, and indeed I should be the last person to assert that any really valuable information would be gained, for I know that every scientific man who has done any good scientific work has failed in very much that he has attempted. But the possibility or even the probability of failure is a poor reason for doing nothing.

If, however, it can be shown that the method of enquiry now adopted furnishes us with all we can know or want to know—if it is as perfect and complete as it can be—if the facts obtained and reported are clearly all the facts required, and all the useful facts that are to be obtained, there is certainly no necessity to employ any other method. But does not every one who has studied the subject of contagion, and indeed the wider subject of the nature of disease, feel how very little is yet known, and how very much there is to learn, and not only so, but how very much we might learn were we to set about the inquiry in a thoroughly earnest manner, employing new means of investigation? There is much to be done by scientific inquiry, and until the numerous questions that suggest themselves to chemists and microscopists have been answered, or, at any rate, until attempts have been made to answer them, all has not been done that might be done.

It may be an absurd suggestion, but to me it seems a most reasonable one, that in such a country as ours there should be scientific advisers appointed from time to time by

the Government,—men who should hold office for short periods only, for in many branches of science progress is so rapid that the aspect is entirely changed every few years, and in some departments a man who was an adept twenty years ago, might not even know how to use instruments only recently invented. Nor is it reasonable to expect that a man of fifty or sixty should take up an entirely new method of inquiry, especially where considerable practice was required to employ it successfully. Moreover, the energy and enthusiasm necessary to enable a man even to attempt a difficult, and to many persons a hopeless scientific task, are much more likely to be found in men of thirty than in men of fifty. These difficult inquiries are the very things for the younger scientific men to attempt, and this may be said without implying the slightest disparagement of the seniors.

It seems time that the Government should be alive to the real usefulness of scientific work for other purposes besides that of forging the most destructive instruments of war. And if in this country we succeed in producing the most effective engines for the destruction of human life, is it not possible that by ingenuity employed in another direction we might ascertain exactly how life may be most efficiently preserved, and rendered most happy while it lasts? The effective prosecution of the latter very wide enquiry may be conducted, and with all the requisite minute details, for a fraction of the thousandth part of what is now spent, and rightly, upon the former.

The wide general bearing and possible practical advantage of many of the most minute and abstract scientific enquiries is as yet but little known to the public, and I may perhaps be permitted to employ one or two illustrations which may help to make this evident.

We know, as yet, very little of the nature of muscular contraction, but this *scientific question* bears in a very important manner upon the practical question how to get the greatest amount of work out of the muscles, and at the same time to preserve them in a healthy state with the smallest expenditure of food. And many will be astonished at the

sort of detailed inquiry which must be undertaken before we can hope to arrive at a thorough knowledge of this subject. It may be possible to ascertain the structure and mode of action of muscles in the lowest animals, while the methods of examination yet known do not enable us to do so in man and the higher animals. We may find by observation that from the fact of the elementary particles of the muscles being larger, or more distinct, in some one of lower simpler creatures than in the higher animals, great facilities are thereby offered for the inquiry, and so a man may spend years upon the study of minute points in the organisation of some worm, in order to determine some general question of the highest importance to mankind, and this may be the only possible method of arriving at sound conclusions. To take another instance. From various circumstances it may be impossible to follow the ultimate arrangement of the nerve fibres in any of the tissues of the higher animals, or to prove, conclusively, by any mode of experiment, the general plan of their distribution, while in some small organ of an insect, or in a transparent papilla upon the surface of some microscopic worm, or mollusk, it may be that a nerve may be followed directly from its centre to its peripheral distribution and back again to the centre. The positive knowledge thus gained, which may have taken months or years to acquire, and apparently so unimportant and useless, might lead almost immediately to the determination for once, and for ever, of the general arrangement of nerves. It might enable us to arrive very shortly at the mode of action of nerves, and the nature of nerve-force, and explain the phenomena of very many nervous diseases now but imperfectly understood, and, perhaps, to far more efficient modes of treatment than any we are now acquainted with. Such enquiries are often prosecuted for years without results, or only with imperfect results; but the examples I have adduced may serve to show that certain minds may find pleasure in striving for what it may be, at least in their day, impossible to obtain; but they strive on, and in spite of failure, for they know that those who have achieved the greatest scientific successes have

for this reason met with, and patiently borne the greatest number of failures. But it is surely well for mankind that there are such men to work, and the work done by them ought to be respected, even though its bearing may not be clear, or its usefulness evident at the time it is performed.

By the above remarks I wish it to be understood that, in my opinion, the scientific part of the investigations in question should be taken up by those alone who have had practical experience of thorough scientific work, and who are inclined to undertake scientific work for its own sake. The work must be thoughtful work done by free men, who will not be paid by the piece or by time. The men who engage in such work should be treated generously, and any one desiring to encourage the prosecution of thorough scientific work of any kind may hope and trust that good results will follow, but should always bear in mind that the work may fail, and never calculate upon what would be called success.

Next, then, let me consider how and by whom the most thorough investigation of the nature of contagious diseases such as, for instance, the cattle plague, can be made. It will be conceded that it is desirable in the first place to ascertain, if possible, the *nature* of the contagious poison, next to discover how it passes from the infected to the sound organism; next to ascertain by what channels it enters the body, and if it is shown that it exists in the blood, it is most important to ascertain the exact changes induced in the composition of this fluid, and the secondary alterations resulting therefrom in the various tissues and organs of the body.

Now it is obvious for conducting such an inquiry as this several different methods of investigation are necessary. Extensive chemical examination must be undertaken with the view of ascertaining in what particulars the fluids and solid organs of the infected organism differ from those in a sound organism, and this at every period of the disease from the moment after the poison gained entrance to the body to the time when the life of the organism attacked is destroyed.

Careful and detailed microscopical examination should be

prosecuted, for the purpose of discovering if any unusual particles existed in the diseased fluids, and demonstrating the exact changes in structure which had taken place in the tissues. And there are very numerous other methods of physical examination, which are also necessary, but to these I shall not allude here. The symptoms occurring during life should of course be accurately noted by persons well accustomed to medical observation, and careful photographs taken of the very same animal at different periods of the malady, of the stalls, &c., in which the animals had been attacked, and of the morbid appearances observed after death.

Here is work for the prosecution of which the assistance of several different persons skilled in many different departments of science will be required.

The desirableness of all this will doubtless be generally admitted, and it will probably occur to every one that so comprehensive an enquiry should at once be set on foot by the Government, because it will be said that to be of any use, such an inquiry must be under the superintendence of some one highly distinguished person.

Now even if the Government thought it right to devote large sums of money to the purpose, it is doubtful if this, the most expensive, would be the most advantageous method of conducting the enquiry, for everything would depend upon the person selected to be at the head. It is scarcely possible to find a man himself well versed practically in all the branches of investigation that would have to be undertaken, while it is obvious that there would be great practical difficulties in obtaining a staff of thorough scientific workers who would submit to carry out the ideas and follow the mandates of one who perhaps knew far less of the subject than the workers themselves. Nor is it reasonable to suppose that a skilled scientific observer would submit to have the precise course he was to pursue dictated by another. Success in laborious scientific investigation seems to be due mainly to the intensity of the energy and enthusiasm of the individual who undertakes it, and for a man to work at anything with energy and enthusiasm, it is necessary that he be perfectly free to

prosecute his work in his own way, and at his own time. Almost all the great work of any kind that has ever been done has been done by those who have freely followed the course which they themselves struck out, and it is most unlikely that a single head or the most admirably chosen committee, whose conclusions might be but a series of compromises between conflicting views, would suggest the exact manner in which each scientific man could think and work to the greatest advantage. The idea, therefore, of a large department with a skilled head, and skilled scientific men following out different branches of an extensive investigation, with one common purpose, is an idea, however perfect it may seem in theory, not likely to work well if carried into practice. The same objections apply and with almost equal force to any attempt being made by a number of private individuals, an association, a company, or a society. No attempt is likely to succeed which does not leave each man free to work in his own way, according to his own views. Chemists, physicists, and microscopists would look at the same inquiry from very different points of view, and each would ascertain facts of a very different nature. The conclusions arrived at might all point in the same direction, or in many different directions. Much capable of immediate application might be gained from their work, or nothing which at the time threw any light upon the question they had been called upon to consider. But I think that however great the objections may be to a scientific inquiry being conducted in this manner, it is only by permitting each person engaged to work in his own free way, that any good results would be rendered possible. Of course he would be able to set assistants to work for him, but he alone would direct them. Any man who has carried out work according to the directions of another, and work as suggested by himself, knows how hard and wearisome is the first, and how light and pleasant the last. There is probably no task more difficult than that of carrying out a prolonged and difficult scientific inquiry according to a scheme designed by another, and especially by one who does not himself take part in the actual work.

Next comes the question whether the nature of contagious poisons and allied scientific inquiries should be practically carried out by men who devote themselves to scientific investigation only, or by members of the medical profession, or, in the case of the prevailing cattle disease, by these and veterinary surgeons conjointly.

The subject is one in which all who devote themselves to medicine are specially interested. Their practical acquaintance with disease would necessarily tend to make them try to study the question in the simplest and also in the most efficient manner possible. The lessons inevitably taught by the constant observation of disease, and the habits of thought inculcated by constant association with sick persons, ought not to make men dogmatists, but rather earnest and thoughtful observers, while nothing can be more likely to kindle in the mind an intense desire to arrive at the truth than the consciousness of the little that is really known even of the nature of diseases which they are daily called upon to treat.

But it may be said, the business of professional life itself unfits the mind for purely scientific investigation, while the imperative engagements of one whose first duty is attendance on the sick so seriously interfere with the laborious prosecution of detailed scientific observation as to impair the value of any results obtained, if not to render them worthless; and it will be remarked that although every medical practitioner has had a scientific education, few in the profession have had an opportunity of pursuing scientific studies for a sufficient period of time to enable them to gain a thorough knowledge of, far less a practical acquaintance with, various details necessary for the useful prosecution of original research.

Again, it has been urged that the followers of medicine are led to put trust in methods of treatment, of the usefulness of which there is the greatest doubt; and that medical men resort to a number of fanciful hypotheses to explain phenomena which they cannot account for in any more satisfactory way, and act as if these hypotheses were actual truths; and hence that such persons are not very likely to arrive at

the truth in a difficult and prolonged scientific inquiry. Of late years medical methods of inquiry have been seriously attacked, and many of our doctrines, formerly regarded sound, and acted upon as if true, have been actually proved by ourselves to have been founded upon false premises. The very first principles of our science have been greatly modified, and not a few distinguished physicists and chemists have asserted that our vague notions concerning the peculiarity, if not mystery, of vital actions, are false. All the wonderful phenomena familiar to us, both in healthy and diseased living beings, have been stated to be due to the ordinary forces of matter, and to these alone. And of late the public has been led to suppose that the progress of physical science has been great indeed, but that medicine has been at a comparative standstill.

But although physicists have made very positive statements concerning many of the changes going on in living beings, they have not as yet added anything to our information concerning the nature of contagious poisons, or of their mode of action. Let it not be supposed, however, that we desire to prevent or to deter purely scientific men from engaging in medical inquiries. We would gladly welcome pure physicists and chemists to our hospitals and medical institutions, and thankful indeed should we be if they were enabled to add to our knowledge of disease.

But it seems to me that there is an unanswerable argument in favour of scientific medical inquiries being undertaken by medical practitioners themselves, viz., that no other scientific men are likely to engage in them, for although they may condemn medical science, investigators in other departments of science will not leave their own special inquiries for the purpose of investigating questions purely medical.

If, then, we cannot expect to obtain the services of distinguished anatomists, physicists, and chemists to assist us in the investigation of disease, it is obvious that if the work is to be done, medical men must make themselves thoroughly acquainted with these branches of science. And indeed medical practitioners have already added far more to these

branches of science than those who devote themselves entirely to their prosecution have added to medicine. Formerly the chief scientific authorities were members of the medical profession. In the present day we may boast of many thorough scientific workers, but we want many more to engage in the investigation of medical scientific questions of the utmost importance to the public, which can be studied only by men who at the same time are thorough doctors, and thorough men of science; and in what way, I would ask, can science be turned to better account practically than in investigating the nature of disease—for every one who has thought at all upon the matter is probably thoroughly anxious that our knowledge of medicine should be extended, because common sense tells him that the more thoroughly we are acquainted with the exact nature of disease, the sounder, and therefore the more effective will be the methods we adopt for its prevention, relief, or cure.

It therefore becomes necessary to consider whether we have among us at this present time men skilled in scientific inquiry. That there are men in our profession capable of prosecuting difficult scientific investigations, must be clear to every one who will be at the trouble of glancing at the transactions of the Royal, Medico-Chirurgical, Chemical, Microscopical, and other learned societies. It is well known that many distinguished chemists and microscopists have been active medical practitioners, while one of the most distinguished physicists of modern times (Mayer) is a medical practitioner. But there can be no doubt that the number of men in our profession capable of undertaking and actually engaged in scientific research is much less than it ought to be, or than it would be in this country, if the public understood the great value of scientific medical work. This is, perhaps, to be attributed partly to the idea that scientific work unfits a man for a practical calling, and partly to the impression that the public has no confidence in any but *practical*, as distinguished from *scientific*, doctors. But it is scarcely necessary to observe—for every reasonable person

must now be convinced of this—that a thorough scientific training and thorough scientific work cannot but make a man a more thoughtful, and necessarily a more careful and judicious practitioner; while it is obvious that such a person must have great advantages in investigating a difficult or doubtful case over one who has not so studied.

Of all departments of scientific inquiry, those bearing upon the study of the nature of, and changes taking place in, disease, may be most conveniently and successfully prosecuted by medical practitioners. Some in active practice have laboratories and work-rooms in their houses, and it is obviously possible for those in very large practice, whose time is much occupied, to employ assistants under their immediate direction to perform much of the detail.

It is certain that if greater facilities were afforded for the scientific investigation of disease, and the work respected as it deserves, there would be no lack of workers. It is, indeed, surprising, that those connected with our great medical charities have not, long ago, taken steps to facilitate the advancement of medicine, instead of devoting their energies and means solely and entirely to the relief of present suffering. There is not yet a hospital in London in which there are efficient means for conducting scientific inquiries into the nature of disease. Not a few benevolent persons will perhaps think that the scientific investigation of disease means, in plain English, performing scientific and necessarily unjustifiable experiments upon the sick poor. Nothing of the kind, however, is thought of by those who are so anxious for the prosecution of scientific medicine. The minute investigation of the secretions, chemical and microscopical; the careful study by the aid of delicate instruments of the state of the pulse and the breath; the analysis of the air breathed by the sick, as well as that of the surrounding atmosphere; the minute examination of diseased organs after death, are points upon which exact information would enable us to draw most important conclusions with reference to the nature of many serious diseases, while such inquiries in no way affect the patient,

and all that is required to carry out such work are well-arranged laboratories and work-rooms in our public hospitals, and qualified officers to do the work. The expense would probably not exceed £500 a year. What the practical results would be if such work were carried out in six or eight of our magnificent hospitals, it is of course impossible to premise, but upon very many grounds we are justified in concluding that the gain to medicine, and indirectly to the public, would be enormous.

The objections previously urged to attempts to organise a large staff of scientific observers for the purpose of prosecuting a special inquiry, apply with equal force to practitioners, as to purely scientific men. It therefore follows that, practically, we are compelled to depend upon the efforts and energies of separate individuals. How then can individual energy be employed most advantageously? It appears to me that, upon the whole, the plan most likely to succeed is an extension of that system which has been many years in operation both in the Royal Society (Government grant) and in the British Association. It seems probable that if the Government would make grants to those who were engaged in scientific researches upon questions of such great public importance as the cattle plague, cholera, &c., great encouragement would be afforded, the number of workers would multiply, and it could scarcely happen but that many new facts would be demonstrated, and, perhaps, discoveries, of which the country might feel justly proud, be made. Grants would not only enable men to enter upon expensive inquiries which they could not otherwise undertake, but would excite a taste for purely scientific inquiry in younger men. I dare say that of a great many grants made, few would be productive of results, but it seems to me that if, out of twenty men set to work, only one produced anything of value, this would be sufficient to prove that the system was successful. In the case of guns and ships how very much we are compelled to spend upon mere failures. I am only pleading for the expenditure of a very small annual sum upon the scientific investigation of disease of the utmost importance to the public—

say £5,000 in grants, of from £50 to £200 to different individuals—and I think that if this sum, or as much of it as might be applied for, were voted annually, very satisfactory results would be apparent in the course of a few years.

Many objections may possibly be made to this plan, and objections may be urged against that already in force, but I think that a careful perusal of the reports of the British Association for the Advancement of Science will satisfy any one that the system of grants upon the whole has worked well, and especially in the case of the Kew Observatory, which has been the largest recipient for many years past.

In the foregoing pages I have been advocating the immediate prosecution of certain lines of investigation, which will to a certainty be followed out, whether or not they be encouraged by the State, by societies, or by wealthy individuals. Some, no doubt, will agree with me in thinking that the private energy and enterprise of individual scientific workers might be advantageously supplemented, assisted, and supported; while others may think it right to leave them alone, until the results obtained are so very decided and so valuable as to command public attention. There is nothing more certain than that very much more concerning the nature of disease will be discovered than seems possible at this present time. The only question for the public to determine is whether such scientific investigations shall be urged on at a rate commensurate with the enormous power of means and work at disposal in this country, or left entirely to the very few who can pursue them unaided. The investigation may be encouraged by our Government, or we may permit the less wealthy Governments of the smaller Continental States to employ the scientific labour of which we shall certainly, as well as they, receive the fruits.

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